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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/731,647	12/09/2003	Antonio L.P. Rotondaro	TI-35226	5024
23494	7590	06/16/2005	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED			THOMAS, TONIAE M	
P O BOX 655474, M/S 3999			ART UNIT	
DALLAS, TX 75265			PAPER NUMBER	
			2822	

DATE MAILED: 06/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

10/731,647

**Applicant(s)**

ROTONDARO ET AL.

**Examiner**

Toniae M. Thomas

**Art Unit**

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 30 March 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

1. This action is in response to the request for consideration filed on 30 March 2005.
2. Currently, claims 1-21 are pending.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. *Claims 1, 10, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Ma et al. (US 6,060,755).*

The Ma et al. reference (Ma) discloses a method for annealing a high dielectric constant (high-k) gate dielectric layer (fig. 14; col. 1, lines 8-12; and col. 6, lines 7-65). The method comprises: placing a wafer including one or more partially formed transistors in an ambient comprising a forming gas (N<sub>2</sub>:H<sub>2</sub>) and an oxidizer, respective transistors comprising a high-k gate dielectric layer formed over a substrate (col. 6, lines 13-26); and heating the high-k gate dielectric layer to a temperature greater than 700 degrees Celsius while the gate dielectric layer is in the ambient, the ambient mitigating the formation of lower dielectric constant (lower-k) material between the high-k gate dielectric layer and the substrate (col. 6, lines 13-26).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. *Claims 2-9, 11-15, and 17-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al. in view of Park (2001/0006843 A1).*

Claims 3, 5, 7, 9, 12, 14, 18, and 20 are unpatentable over Ma as applied above (see col. 6, lines 13-26 and col. 6, lines 55-61). Regarding claim 7, the likelihood of crystallization of the high-k material is mitigated (col. 3, lines 53-61).

As stated above Ma discloses heating the high-k material in an ambient comprising a forming gas (N<sub>2</sub>:H<sub>2</sub>) and an oxidizer. Whereas Ma discloses heating in an ambient comprising a forming gas (N<sub>2</sub>:H<sub>2</sub>) and an oxidizer, Ma lacks anticipation in not teaching that the ambient comprises ammonia (NH<sub>3</sub>), as recited in claims 2, 11, and 17. The Park pre-grant published application (Park) discloses a method for forming a gate dielectric layer over a substrate (figs. 1-5 and accompanying text). The method comprises performing a heat treatment in an ambient comprising either NH<sub>3</sub> or N<sub>2</sub>:H<sub>2</sub> (par. 27, lines 1-5). Park suggests that NH<sub>3</sub> and N<sub>2</sub>:H<sub>2</sub> are art-recognized equivalents.

Since Ma and Park are from the same field of endeavor, the purpose for which Park is relied upon would have been recognized in the pertinent reference of Ma by one of ordinary skill in the art at the time the invention was made.

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify Ma in view of Park by substituting the forming gas  $N_2:H_2$  with  $NH_3$ , as taught by Park, since the forming gas  $N_2:H_2$  and  $NH_3$  are art-recognized equivalents.

Ma does not teach that a greater concentration of the oxidizer is included in the ambient when nitrogen is pre-existing within the high-k material, as recited in claim 8. However, controlling the oxidizer in the ambient to obtain the desired result is well within ordinary skill. Thus, claim 8 is taken to be obvious over the combination of Ma and Park.

Ma does not teach maintaining the high-k dielectric layer and ambient under a pressure of about 200 Torr, as recited in claims 4, 13, and 19; or maintaining the high-k dielectric layer and ambient under a pressure of about 20 Torr, as recited in claims 6, 15, and 21. However, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to maintain the high-k dielectric layer and ambient under the claimed pressure, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art (*In re Boesch*, 617 F.2d, 272, 205 USPQ 215 (CCPA 1980)).

***Response to Arguments***

5. Applicant's arguments filed 30 March 2005 have been fully considered but they are not persuasive.

The Applicant argues that:

while hydrogen, nitrogen, and oxidizers are included in the laundry list of gases, there is no guidance in Ma for choosing among the list an ambient that combines hydrogen, nitrogen and oxidizer so as to mitigate the formation of lower dielectric constant (lower-k) material between the high-k gate dielectric layer and the substrate. This would amount to looking for a needle in the haystack without guidance as to the characteristics of the needle you are looking for...While this implies that some combination may be used, it does not suggest the specific combination of hydrogen, nitrogen, and oxidizer as claimed. While N<sub>2</sub>:H<sub>2</sub> may be selected by chance, there is no guidance for choosing N<sub>2</sub>:H<sub>2</sub> over the other listed inert gases Ar or N<sub>2</sub>.

As explained in this Office action and in the action mailed on 01 October 2004, Ma discloses placing a wafer in an ambient comprising an inert gas and/or an oxidizer (see Ma - col. 6, lines 13-26). In one preferred embodiment, the inert gas is an N<sub>2</sub>:H<sub>2</sub> forming gas. Thus, Ma clearly anticipates an ambient comprising hydrogen, nitrogen, and an oxidizer as claimed.

***Conclusion***

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on

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the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toniae M. Thomas whose telephone number is (571) 272-1846. The examiner can normally be reached on Monday through Friday from 8:30 a.m. to 5:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TMT  
13 June 2005



**Mary Wilczewski**  
Primary Examiner